

June 5, 2001

MEMORANDUM

SUBJECT: RESPONSE TO COMMENTS ON THE PRELIMINARY RISK ASSESSMENT (PRA) FOR LINDANE AND ADDITION OF TREATMENT FOR CANOLA SEED (PC Code 009001, DP Code D275419)

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1.0 INTRODUCTION

RRB4 has been requested to respond to comments from the registrant and others to the Preliminary Risk Assessment (PRA) for Lindane which was issued in August 2000. The comments, the majority of which were received from the registrant, are addressed individually below.

The registrant has raised a number of issues regarding the exposure/risk assessment for lindane which was issued in March 2001. A major comment is in regard to the dermal absorption value. The PRA assumed a 10 percent dermal absorption factor and the registrant believes that a value of 2 percent should be used for risk assessment. Determination of dermal absorption is not within the purview of exposure assessors and, to date, no changes have been indicated by Agency toxicologists. The inhalation NOAEL has changed to 0.13 mg/kg/day FOR **intermediate exposures**(S. Shallal communication via EMAIL, 5/18/2001). This will not change the assessment for either on farm seed treatment or planting of the treated seed since these are considered to be short term scenarios only. In addition, since the production of the PRA, the Health Effects Division Exposure Science Advisory Council (EXPOSAC) has adopted a revised series of inhalation volumes according to a NAFTA agreement. These values are presented in Appendix A.

2.0 Conclusions

The registrant correctly notes that a sentence in the document addressing occupational and residential exposures (Memorandum from D. Jaquith to S Shallal titled “Occupational and Residential Exposure Assessment and Recommendations for the Reregistration Eligibility Decision Document for Lindane”, D254759 dated March 16, 2001) states that the dermal MOEs are less than 100 for both short term and intermediate term exposures when an on farm treatment is short term only. This does not, however, change the MOEs since the NOAEL for both scenarios (1.2 mg/kg/day) is the same for both short term and intermediate term exposure.

The registrant has also indicated that the two studies used by the Agency are out-of-date with regard to seed treatment practices and overestimate exposure. The Agency noted, on page 12 of the exposure assessment under *Data Gaps*, that current technology, particularly for commercial treatments, is more automated and that exposures may be less than those from the existing studies. The registrant has not submitted data with which to support this hypothesis. The on farm treatments, while possibly fairly uncommon, would probably yield similar exposures to the study used for the exposure assessment. A revision of Table 7 from the PRA, incorporating the new inhalation NOAEL and NAFTA respiration volumes, is presented below

The Agency has also included an assessment for use of lindane to treat canola seed. The application rate for canola is much higher than that for other types of seed. However, the application rate per acre of seed planted is very similar to that used in the PRA (wheat planting). Therefore no changes have been incorporated for the seed planting procedures.

Table 14: Daily Exposures, Short Term MOEs and Intermediate MOEs of Workers to Lindane During Seed Treatment and Planting of Treated Seed.

Exposure Scenario (Scenario #)	Range of Application Rates (lb ai/100 lbs seed OR Lb/A)	Amount Handled per Day (lbs ai)	Unit Exposure (mg/lb ai)		Daily Exposure (mg/kg/day)		Short-Term MOEs		Intermediate,- Term MOEs	
			Dermal	Inhalation	Dermal	Inhalation	Dermal	Inhalation	Dermal	Inhalation
Mixing/loading/planting dry formulation for on farm seed treatment (1)	0.038	4.7	9.4 ^c	0.0016	0.063	0.0001	19	1200	Intermediate-term not applicable for this scenario	
Mixing/loading/application of liquid formulation for commercial seed treatment (2)	0.04	8.8 (Small facility, 22000 lbs seed/day)	0.063 ^d	0.0014	0.00081	0.00018	1500	2800	1500	722
		8.8 (Medium facility, 22000 lbs seed/day)	0.063 ^d	0.0014	0.00081	0.00018	1500	2800	1500	722
		66 (Large Facility, 165000 lbs seed/day)	0.063 ^d	0.0014	0.0059	0.0013	200	380	200	100
Seed Handler for commercial seed treatment (3)	0.04	8.8 (Small facility, 22000 lbs seed/day)	0.0022 ^d	0.00018	0.000028	0.000023	43000	5700	43000	5700
		8.8 (Medium facility, 22000 lbs seed/day)	0.0022 ^d	0.00018	0.000028	0.000023	43000	5700	43000	5700
		66 (Large Facility, 165000 lbs seed/day)	0.0022 ^d	0.00018	0.00021	0.0002	5700	760	5700	650
Loading treated seed for planting (4)	0.038	4.7	0.0069 ^e	0.0017	0.000046	0.000073	26000	1800	Intermediate-term not applicable for this scenario	
Planting treated seed (5)	0.038	4.7	0.0021 ^e	0.00022	0.000014	0.000010	86000	13000	Intermediate-term not applicable for this scenario	

Table 14: Daily Exposures, Short Term MOEs and Intermediate MOEs of Workers to Lindane During Seed Treatment and Planting of Treated Seed.

Exposure Scenario (Scenario #)	Range of Application Rates (lb ai/100 lbs seed OR Lb/A)	Amount Handled per Day (lbs ai)	Unit Exposure (mg/lb ai)		Daily Exposure (mg/kg/day)		Short-Term MOEs		Intermediate,- Term MOEs	
			Dermal	Inhalation	Dermal	Inhalation	Dermal	Inhalation	Dermal	Inhalation
^a Daily Exposure (mg/kg/day) = mg/lb ai x lb ai/day x 0.1 (Absorption factor) ÷ 70 kb bw ^b Daily Exposure (mg/kg/day) = mg/lb ai x lb ai/day ÷ 70 kg bw ^c Assumes single layer of clothing and gloves ^d Assumes coveralls over single layer of clothing and gloves ^e Assumes closed cab, single layer of clothing and no gloves										

3.0 Addition of Exposure Values for Canola Seed Treatment

The exposure estimates for treatment of canola seed were derived from a published study addressing commercial seed treatment, which the registrant considers to be out of date, and application information provided by the registrant. The application rate for lindane on canola seed is 23.3 ounces of active ingredient per 100 lbs of seed, much higher than that for other types of seed. Using the amounts of seed treated per day from the commercial seed treatment study (3000 25 kg bags for a large facility and 400 25 kg bags for medium/small facilities) the amount of active ingredient handled per day would be:

Large facility:

Amount handled (lb ai/day) = 3000 bags/day x 25 kg/bag x 2.2 lb/kg x 23.3 oz ai/100 lbs seed x 1 lb ai/16 oz ai = 2400 lb ai/day

Medium/Small facility:

Amount handled (lb ai/day) = 400 bags/day x 25 kg/bag x 2.2 lb/kg x 23.3 oz ai/100 lbs seed x 1 lb ai/16 oz ai = 320 lb ai/day

The unit exposures from the seed treatment study are presented below.

Summary of the Exposure values of Canola Seed Treatment to Lindane in Canada		
Scenario	mg/lb ai (no gloves)	mg/lb ai (gloves)
Loader/Applicator (Dermal)	0.36	0.063
Seed Handler (Dermal)	0.015	0.0022
Loader/Applicator (Inhalation)	0.0014	0.0014
Seed Handler (Inhalation)	0.00018	0.00018

LARGE FACILITY:

Using these values, the daily exposures and MOEs for a **large** facility are:

For the Loader/Applicator (No Gloves):

Daily Dermal Exposure (mg/kg/day) = 0.36 mg/lb ai x 2400 lb ai/day x 0.10 ÷ 70 kg = 1.2 mg/kg/day

The MOE (NOAEL = 1.2 mg/kg/day) is:

$$\text{MOE} = 1.2 \text{ mg/kg/day} / 1.2 \text{ mg/kg/day} = 1.0$$

Loader/Applicator With Gloves:

Daily Dermal Exposure (mg/kg/day) = 0.063 mg/lb ai x 2400 lb ai/day x 0.10 ÷ 70 kg = 0.22 mg/kg/day

The MOE (NOAEL = 1.2 mg/kg/day) is:

$$\text{MOE} = 1.2 \text{ mg/kg/day} / 0.22 \text{ mg/kg/day} = 5.5$$

The inhalation exposure is for the loader/applicator is:

Inhalation Exposure (mg/kg/day) = $0.0014 \text{ mg/lb ai} \times 2400 \text{ lb ai/day} \div 70 \text{ kg} = 0.048 \text{ mg/kg/day}$

Using the new NOAEL of 0.13 mg/kg/day the MOE is:

$$\text{MOE} = 0.13 \text{ mg/kg/day} / 0.048 \text{ mg/kg/day} = 2.7$$

If a respirator, offering 90 percent protection, is worn this yields a MOE of 27

For the **seed handler** at a large facility the exposures and MOEs are:

For the seed handler (No Gloves):

Daily Dermal Exposure (mg/kg/day) = $0.015 \text{ mg/lb ai} \times 2400 \text{ lb ai/day} \times 0.10 \div 70 \text{ kg} = 0.051 \text{ mg/kg/day}$

The MOE (NOAEL = 1.2 mg/kg/day) is:

$$\text{MOE} = 1.2 \text{ mg/kg/day} / 0.051 \text{ mg/kg/day} = 24$$

Seed handler With Gloves:

Daily Dermal Exposure (mg/kg/day) = $0.0022 \text{ mg/lb ai} \times 2400 \text{ lb ai/day} \times 0.10 \div 70 \text{ kg} = 0.0076 \text{ mg/kg/day}$

The MOE (NOAEL = 1.2 mg/kg/day) is:

$$\text{MOE} = 1.2 \text{ mg/kg/day} / 0.0076 \text{ mg/kg/day} = 160$$

The inhalation exposure is for the seed handler is:

Inhalation Exposure (mg/kg/day) = $0.00018 \text{ mg/lb ai} \times 2400 \text{ lb ai/day} \div 70 \text{ kg} = 0.0062 \text{ mg/kg/day}$

Using the new NOAEL of 0.13 mg/kg/day the MOE is:

$$\text{MOE} = 0.13 \text{ mg/kg/day} / 0.0062 \text{ mg/kg/day} = 21$$

If a respirator, offering 90 percent protection, is worn this yields a MOE of 210

MEDIUM/SMALL FACILITY:

Using these values, the daily exposures and MOEs for a **medium/small** facility are:

For the Loader/Applicator (No Gloves):

Daily Dermal Exposure (mg/kg/day) = $0.36 \text{ mg/lb ai} \times 320 \text{ lb ai/day} \times 0.10 \div 70 \text{ kg} = 0.16 \text{ mg/kg/day}$

The MOE (NOAEL = 1.2 mg/kg/day) is:

$$\text{MOE} = 1.2 \text{ mg/kg/day} / 0.16 \text{ mg/kg/day} = 7.5$$

Loader/Applicator With Gloves:

Daily Dermal Exposure (mg/kg/day) = $0.063 \text{ mg/lb ai} \times 320 \text{ lb ai/day} \times 0.10 \div 70 \text{ kg} = 0.029 \text{ mg/kg/day}$

The MOE (NOAEL = 1.2 mg/kg/day) is:

$$\text{MOE} = 1.2 \text{ mg/kg/day} / 0.029 \text{ mg/kg/day} = 41$$

The inhalation exposure is for the loader/applicator is:

Inhalation Exposure (mg/kg/day) = $0.0014 \text{ mg/lb ai} \times 320 \text{ lb ai/day} \div 70 \text{ kg} = 0.0064 \text{ mg/kg/day}$

Using the new NOAEL of 0.13 mg/kg/day the MOE is:

$$\text{MOE} = 0.13 \text{ mg/kg/day} / 0.0064 \text{ mg/kg/day} = 20$$

If a respirator, offering 90 percent protection, is worn this yields a MOE of 200

For the **seed handler** at a large facility the exposures and MOEs are:

For the seed handler (No Gloves):

Daily Dermal Exposure (mg/kg/day) = $0.015 \text{ mg/lb ai} \times 320 \text{ lb ai/day} \times 0.10 \div 70 \text{ kg} = 0.0069 \text{ mg/kg/day}$

The MOE (NOAEL = 1.2 mg/kg/day) is:

$$\text{MOE} = 1.2 \text{ mg/kg/day} / 0.0069 \text{ mg/kg/day} = 170$$

Seed handler With Gloves:

Daily Dermal Exposure (mg/kg/day) = $0.0022 \text{ mg/lb ai} \times 320 \text{ lb ai/day} \times 0.10 \div 70 \text{ kg} = 0.0010 \text{ mg/kg/day}$

The MOE (NOAEL = 1.2 mg/kg/day) is:

$$\text{MOE} = 1.2 \text{ mg/kg/day} / 0.0010 \text{ mg/kg/day} = 1200$$

The inhalation exposure is for the seed handler is:

Inhalation Exposure (mg/kg/day) = $0.00018 \text{ mg/lb ai} \times 320 \text{ lb ai/day} \div 70 \text{ kg} = 0.00082 \text{ mg/kg/day}$

Using the new NOAEL of 0.13 mg/kg/day the MOE is:

$$\text{MOE} = 0.13 \text{ mg/kg/day} / 0.00082 \text{ mg/kg/day} = 160$$

If a respirator, offering 90 percent protection, is worn this yields a MOE of 1600

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APPENDIX A.

POSITION PAPER

Issue: Standard Reference Values

Agency Approaches:

USEPA:

The USEPA's guidance for selecting standard reference values is dictated by the Exposure Factors Handbook (USEPA, 1997). In some cases, the Exposure Factors Handbook provides specific recommendations for selecting exposure factors.

It is the Office of Pesticides' policy to use these recommendations. Although the Exposure Factors Handbook recommends specific values, it also allows the assessor to select other values along the distribution. For example, the Exposure Factors Handbook recommends the arithmetic mean for adult surface area, but states that median values may be used "*when surface area distributions are preferred.*" The Office of Pesticides harmonized the selection of the surface area for adults with Health Canada and California Department of Pesticide Regulation (DPR) and selected the median value. Therefore, to consistently use the median value, OPP has also selected the median body weight (i.e., 70 kg median body weight, not the Exposure Factors Handbook recommended mean value of 71.8 kg).

Health Canada:

a) Body weights: Health Canada's guidance for selecting standard body weights is dictated by CEPA's 1994 document entitled *Human Health Risk Assessment for Priority Substances* (CEPA, 1994). The overall standard body weight was set at 70 kg for adults 20 years and older. In cases where separate male and female body weights are required, the USEPA Exposure Factors Handbook (USEPA, 1995) was used. Male body weight was set at 78.1 kg (rounded to 78 kg), while female body weight was set at 65.4 kg (rounded to 65 kg).

b) Surface area: Health Canada's guidance for surface area was based upon the values presented in USEPA's Pesticide Assessment Guidelines - Subdivision U (USEPA, 1987).

c) Inhalation rate: For pesticide evaluations, Health Canada's guidance for inhalation rate was also based upon USEPA's Pesticide Assessment Guidelines - Subdivision U (USEPA, 1987). A value of 29 L/min was set for males performing light work (which was determined to be the equivalent of most pesticide activities). A value of 16 L/min was set for females performing light work.

Guidance for long-term exposure and/or other types of evaluations is dictated by CEPA's 1994 document entitled *Human Health Risk Assessment for Priority Substances*. The overall value for adults 20 years and older was set at 23 m³/day.

d) Life expectancy: Life expectancy values were based on the USEPA Exposure Factors Handbook (USEPA, 1995). The overall figure is 70 years for males and females combined.

DPR:

The DPR's guidance document, HS-1612 (Thongsinthusak *et al.*, 1993) shows standard reference values for adult body weights, surface areas, inhalation rates, and life expectancy. This document does not incorporate standard reference values for children; these values were adopted from USEPA (1985), USEPA (1990) or ICRP (1975) whenever they are applicable for exposure assessment.

a) Body weights and surface areas - DPR has adopted 50th percentile adult body weights and surface areas for adult males and females as reported in USEPA (1985). The adopted body weight (kg) and surface area (cm²) for adult males are 75.9

and 19,400, and that for females are 61.5 and 16,900, respectively. Actual surface areas can also be estimated from an equation shown in USEPA (1985); parameters used in the equation are similar to those of Gehan and George (1970).

b) Inhalation rates - Inhalation rates for adult males and females were adapted from USEPA (1985). The rate (L/min) for resting, light, moderate, and heavy activities for males are 12, 14, 41, and 80, and that for females are 6, 8, 27, and 48, respectively.

c) Life expectancy - DPR adopted a life expectancy of 75 years (Bureau of the Census, 1991) for use in the estimation of lifetime average daily dosage.

Harmonization Status:

- All Agencies are in agreement to use standard reference values shown in the attached Tables 1(Adult Exposure Factors Recommended by NAFTA (USEPA, Health Canada, and California DPR)) and 2 (Child Exposure Factors Recommended by NAFTA (USEPA, Health Canada, and California DPR)).

Recommendations for Continued Progress:

The agencies will recommend changes whenever there are more appropriate standard reference values in the future.

Table 1. Adult Exposure Factors Recommended by NAFTA (USEPA, Health Canada, and California DPR).

Scenario	NAFTA Recommendations			
	Gender Specific			Comments
	Males	Females	Males & Females	
Body Weight (kg)	76.9 (round to 77)	62.4 (round to 62)	69.7 (round to 70)	<p>Median values (USEPA, 1997). Value for <u>Males & Females</u> represents the average of the <u>median</u> body weights for males and females (USEPA, 1997). NAFTA recommends using data for either sex or the average of both sexes, depending on whether sex was specified in the study. If both males and females were included in a study the male/female average should be used. Note: USEPA may use 71.8 kg (males and females) once the Exposure Factors Handbook is finalized. However, since the median value for surface area has been selected, the median body weight should also be used.</p> <p>Surface areas for individual body parts represent median values from USEPA (1997). <u>Male upper arms</u> represent the value for arms minus the value for forearms. <u>Female upper arms and forearms</u> are based on the data for arms, assuming the same ratio of upper arms to forearms as for males. <u>Totals</u> represent the sum of the median values for individual parts. Although it is not entirely correct to sum percentile values, it allows for consistency between the individual body parts data and the totals. Another appropriate method might be to use the median total surface areas, and the percentages of each body part to estimate surface areas for each part. This would also ensure consistency with total surface area. Values for males and females combined were calculated by averaging the data sets for the two groups. NAFTA recommends using the median values for either sex or the average of both sexes, depending on whether sex was specified in the study. If both males and females were included in a study the male/female average should be used. The body surface areas in PHED V2.0 will be switched to the male surface area. Although USEPA (1997) recommends using the mean surface areas, it also states that the median values maybe used "when surface area distributions are preferred".</p>
Surface Area (cm ²)				
Head	1,300	1,110	1,205	
Trunk (including neck)	7,390	5,790	6,590	
Arms	-	-	-	
Upper Arms	1,600	1,265	1,433	
Forearms	1,310	1,035	1,173	
Hands	990	817	904	
Thighs	3,820	3,260	3,540	
Lower Legs	2,560	2,180	2,370	
Feet	1,310	1,140	1,225	
Total	20,280	16,597	18,440	
Life Expectancy (years)	72.1	78.9	75	
Working Lifetime (years)	-	-	40	

Scenario	NAFTA Recommendations			
	Gender Specific			Comments
	Males	Females	Males & Females	
				For the antimicrobial uses it is recommended that specific values from the Exposure Factors Handbook be used for various industries. USEPA (1997) allows occupational specific values such as the one selected by NAFTA.
Chronic Inhalation Rates (m ³ /day)	15.2	11.3	13.3	Based on the averages of Layton's (1993) three approaches for calculating inhalation rates (i.e., using average daily food energy equivalents, basal metabolic rates, and energy expenditure based on activity level), as presented in USEPA (1997). A value for males and females combined is not provided in USEPA (1997), but is recommended by NAFTA by estimating the average of the male and females values (i.e., 13.3 m³/day).
Short- and intermediate-term Inhalation Rates (m ³ /hr)				<p>Based on the average of several studies (Adams, 1993; Layton, 1993; Linn et al., 1992) presented in USEPA (1997). NAFTA discussed reporting values for male and female, however, several methods were used to calculate the combined male and female values (e.g., age groups, time activity, and basal metabolic rates). Recalculating the male and female values separately is out of the scope of this project. If gender specific values are needed, NAFTA recommends using the values reported by Layton in USEPA (1997).</p> <p>The activities correspond to the following:</p> <p>Rest -lying down, Sedentary - sitting, pilot, driving a tractor, Light - flagger, mixer/loader (containers < 50 lb), pneumatic reel sprayer, lawn treatment, most harvesters, Moderate - mixer/loader (containers > 50 lb), backpack sprayer (greenhouse, hilly conditions, heavy brush), harvesters using ladders, Heavy - generally not applicable to occupational exposure to pesticides.</p>
Rest	-	-	0.4	
Sedentary Activity	-	-	0.5	
Light Activity	-	-	1.0	
Moderate Activity	-	-	1.6	
Heavy Activity	-	-	3.2	

Table 2. Child Exposure Factors Recommended by NAFTA (USEPA, Health Canada, and California DPR).

Scenario	NAFTA Recommendations			Comments
	Gender Specific			
	Males	Females	Males & Females	
Body Weight (kg)				Mean values (USEPA, 1997), and median values in parentheses. The value for Males & Females represents the average of the median body weights for males and females. Mean values for males & females are not reported, but these values can be calculated by averaging the mean male and female values for each age group. NAFTA recommends using the median values (reported in parentheses) to be consistent with the use of the median surface areas.
6-11 months	9.4 (9.4)	8.8 (8.9)	(9.2)	
1 year	11.8 (11.7)	10.8 (10.7)	(11.2)	
2 years	13.6 (13.5)	13.0 (12.7)	(13.1)	
3 years	15.7 (15.4)	14.9 (14.7)	(15.1)	
4 years	17.8 (17.6)	17.0 (16.7)	(17.2)	
5 years	19.8 (19.4)	19.6 (19.0)	(19.2)	
6 years	23.0 (22.0)	22.1 (21.3)	(21.7)	
7 years	25.1 (24.8)	24.7 (23.8)	(24.3)	
8 years	28.2 (27.5)	27.9 (27.5)	(27.5)	
9 years	31.1 (30.2)	31.9 (29.7)	(30.0)	
10 years	36.4 (34.8)	36.1 (34.5)	(34.7)	
11 years	40.3 (37.3)	41.8 (40.3)	(38.8)	
12 years	44.2 (42.5)	46.4 (45.4)	(44.0)	
13 years	49.9 (48.4)	50.9 (49.0)	(48.7)	
14 years	57.1 (56.4)	54.8 (53.1)	(54.8)	
15 years	61.0 (60.1)	55.1 (53.3)	(56.7)	
16 years	67.0 (64.4)	58.1 (55.6)	(60.0)	
17 years	66.7 (65.8)	59.6 (58.4)	(62.1)	
18 years	71.1 (70.4)	59.0 (56.4)	(63.4)	
Total Surface Area (cm ²)				Surface areas for individual age groups represent the recommended median values from USEPA (1997), except for the <1 and 1 < 2 year age groups which were taken from ICRP (1981). NAFTA recommends using the male and female combined values that are based on the average of the median male and female data, unless gender specific data are warranted.
< 1 year	-	-	3925	
1 < 2 years	-	-	5275	
2 < 3 years	6030	5790	5910	
3 < 4 years	6640	6490	6565	
4 < 5 years	7310	7060	7185	
5 < 6 years	7930	7790	7860	
6 < 7 years	8660	8430	8545	

Scenario	NAFTA Recommendations						Comments
	Gender Specific						
	Males		Females		Males & Females		
7 < 8 years	9360		9170		9265		Based on mean percentages for males and females combined from USEPA (1997). Values with *'s estimated using regression analyses.
8 < 9 years	10000		10000		10000		
9 < 10 years	10700		10600		10650		
10 < 11 years	11800		11700		11750		
11 < 12 years	12300		13000		12650		
12 < 13 years	13400		14000		13700		
13 < 14 years	14700		14800		14750		
14 < 15 years	16100		15500		15800		
15 < 16 years	17000		15700		16350		
16 < 17 years	17600		16000		16800		
17 < 18 years	18000		16300		17150		
Percentage of Surface Area of Body Parts (%)	head	trunk	arms	hands	legs	feet	
< 1 year	18.2	35.7	13.7	5.3	20.6	6.54	
1 < 2 years	16.5	35.5	13	5.68	23.1	6.27	
2 < 3 years	14.2	38.5	11.8	5.3	23.2	7.07	
3 < 4 years	13.6	31.9	14.4	6.07	26.8	7.21	
4 < 5 years	13.8	31.5	14	5.7	27.8	7.29	
5 < 6 years	13.5*	34.7*	13.4*	5.46*	26.0*	7.04*	
6 < 7 years	13.1	35.1	13.1	4.71	27.1	6.9	
7 < 8 years	12.3*	34.4*	13.5*	5.44*	27.3*	7.13*	
8 < 9 years	11.7*	34.2*	13.6*	5.43*	27.9*	7.17*	
9 < 10 years	12	34.2	12.3	5.3	28.7	7.58	
10 < 11 years	10.7*	33.8*	13.7*	5.39*	29.2*	7.24*	
11 < 12 years	10.2*	33.6*	13.8*	5.38*	29.8*	7.27*	
12 < 13 years	8.74	34.7	13.7	5.39	30.5	7.03	
13 < 14 years	9.97	32.7	12.1	5.11	32	8.02	

Scenario	NAFTA Recommendations						Comments
	Gender Specific						
	Males		Females		Males & Females		
14 < 15 years	8.81*	32.9*	13.9*	5.31*	31.7*	7.35*	Specific Ages: Based on the data from Layton (1993) and presented in USEPA (1997) that uses energy intakes to estimate inhalation rates. The Male & Female combined values for the 9-11, 12-14, and 15-18 age groups were calculated from the values reported in USEPA (1997).
15 < 16 years	8.39*	32.7*	14.0*	5.27*	32.3*	7.37*	
16 < 17 years	7.96	32.7	13.1	5.68	33.6	6.93	
17 < 18 years	7.58	31.7	17.5	5.13	30.8	7.28	
Chronic Inhalation Rates (m³/day)							
< 1 year	-		-		4.5		
1-2 years	-		-		6.8		
3-5 years	-		-		8.3		
6-8 years	-		-		10		
9-11 years	14		13		13.5		
12-14 years	15		12		13.5		
15-18 years	17		12		14.5		
Short- and intermediate-term Inhalation Rates (m³/hr)	6 years old		-		-		Based on the mean from two reports (Astrand, 1952; Robinson, 1938) presented in USEPA (1985) and USEPA (1997). The ratios of ventilation rate and BW are highest for 6-year old male children. The ratios for 6-year old female children are not available.
Rest	0.4		-		-		
Light Active	0.8		-		-		
Moderate Active	2.0		-		-		
Heavy Active	2.3		-		-		

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